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ABSTRACT

The role of inference in children's comprehension and memory is the subject of this research report. An underlying proposition is that in order for a child to effectively understand and remember linguistic or nonlinguistic information, he must actively embellish the given stimulus material with his own implicit knowledge. In the experiment described the authors sought to assess the developmental changes in the child's ability to infer and remember different kinds of linguistic information with children in grades K through five. Six paragraphs were read to each child; after each of these they were asked 8 Yes/No questions. Four questions were of verbatim information and four were of the different linguistic inferences being studied (presuppositions, inferred consequences, semantic entailment, and implied instruments). Age-related improvements were found for the verbatim information and for the spontaneous processing of implicit information, as well. There is an increased proficiency with age spontaneously performing inferential operations on linguistic material, which may be useful information for those constructing language or reading comprehension instruments. (Author/ED)

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Children's Comprehension of Implicit and Explicit Information in Paragraphs

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Today I would like to discuss some of our research concerning the role of inference in children's comprehension and memory. An underlying proposition of our approach is that in order for a child to effectively understand and remember linguistic or nonlinguistic information, he must actively embellish the given stimulus material with his own implicit knowledge. Our initial studies, therefore, were addressed to the question, "Do children spontaneously embellish and operate upon available information during comprehension?" We employed a recognition memory task to assess this constructive process. In a series of studies, elementary school children of various ages and IQs were read a series of brief paragraphs or were shown sets of related pictures and told to remember the stimulus items (Paris & Carter, 1973; Paris & Mahoney, 1974; Paris, Mahoney & Buckhalt, 1974). Each set of sentences and pictures was constructed in such a way that an inferential relationship existed among the sentences or pictures. During the recognition memory test, subjects were shown some Old and some New stimuli. However, there were crucial differences among the New items. Some of the New items were inferential pictures or sentences which were semantically consistent with the original stimuli while others portrayed semantically false relationships. It was observed that subjects could not discriminate Old items from New items which preserved inferentially correct relationships but they readily differentiated false items.

We regarded this as evidence that children implicitly integrated and elaborated the given information in sets of related sentences and pictures and derived a contextual, wholistic representation of the meaning in memory. This constructive process of inference and integration is generically similar to assimilation or the incorporation of new information into existing schemata. However, even if this process is regarded as a functionally invariant strategy employed by children and adults (cf., Bransford & Franks, 1972) in their efforts to understand and remember language, it can yield structurally different, developmental levels of understanding. The purpose of our research was to determine the interaction of constructive comprehension processes and the developmental levels of knowledge which children bring to bear on the understanding of prose. The present study was an examination of the structural aspects of children's inferential comprehension. In particular, we wanted to assess the developmental

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changes in ability to infer and remember different kinds of linguistic information.

We chose four different linguistic inferences to study. The first two we labelled contextual inferences because they required the amalgamation of information from several sentences. These were: presuppositions, the pre-existing conditions necessary to make a sentence or paragraph true; and inferred consequences, the probable end result of a series of statements or conditions. The other two inferences were termed lexical inferences because the inferential relationship was dependent upon a single word. These included semantic entailment; a word is a subset of a larger class; and implied instruments, a verb implies a particular instrument to accomplish the action.

We constructed six paragraphs ranging from seven to nine sentences which permitted these inferences. The paragraphs were read to individual subjects, 12 each from Grades K through 5. Immediately after listening to a paragraph, subjects were asked eight Yes/No questions concerning the story. Four of these questions were the previously described inferences. We also asked four questions of verbatim information in order to prevent subjects from biasing their processing towards only inferential relationships and in order to provide a baseline comparison of explicit information retention. The verbatim items included prenominal adjectives such as big, new, and red and locative prepositions such as in, over, and under. The eight questions were balanced for verbatim and inferential items as well as truth-falsity within each category. The orders of paragraphs and questions were randomized for every subject.

The mean percentages of correct responses for verbatim and inferential questions for each grade level are shown in Figure 1. Performance improved monotonically across grades showing the sensitivity of this task to differences between children's comprehension and memory in successive grades. Figure 1 also illustrates the superiority of inferential items. Both the Grade and Question type factors yielded highly significant F-ratios ($p < .01$). We also treated our stimulus materials as random factors and computed the appropriate quasi-F-ratios which again yielded significant Grade and Question effects. A response bias is often observed in young children and, indeed, our kindergarten subjects responded affirmatively to 72% of the questions while fifth-graders responded affirmatively only 48% of the time. A signal detection analysis takes response bias into account and we therefore calculated d's for the data points in Figure 1. These are shown in Figure 2 and it is evident that both effects are robust against response bias.

The categories of Questions are further broken down in Figure 3 where it can be seen that lexical inferences were much easier to process than other items, possibly because they involved operations on nouns and verbs. However, it should be noted that there is an age-related improvement on the same items within all categories. We do not want to emphasize absolute comparisons among categories on this task, rather, we want to ask if there is developmental improvement for the operations of inference and the spontaneous processing of implicit information above and beyond developmental increases in memory span.

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In order to answer this question, we will assume that a correct answer to a verbatim question involves memory for a bit of information while a correct answer to an inferential question involves remembering the information plus performing an inferential operation. In essence, we can regard the developmental improvement on verbatim items as evidence for improvement in memory capacity and ask if the developmental effects for inferences merely parallel this curve or interact with it.

The simplest manner to observe this interaction is to inspect the curves for some of the questions. When we compare prenominal adjectives with inferred consequences, for example as illustrated in Figure 4, we observe dramatic improvement in the comprehension of this inference which does not parallel a memory curve.

We partialled out the effects of memory improvement from the inferential operations by computing an analysis of covariance and covarying out the effects of verbatim items. When we did this, our adjusted scores, shown in Figure 5, still revealed significant developmental improvement in the inferential operations. As in other figures, the more difficult contextual inferences again account for the majority of the improvement. This interaction appears to be independent of response bias as shown in the d's of Figure 6 and the greater comprehension and memory for contextual inferences with age appears to reflect more than increased memory span.

The results of this study suggest that children from six to eleven years of age increase the amount of both explicit and implicit information that they comprehend from paragraphs. Even when we take into account the variability due to paragraphs, items, and response bias, there is an increased proficiency with age of spontaneously performing inferential operations on linguistic material.

A few caveats are in order, though. Certainly, comprehension and memory are related and developmental improvements in one should facilitate the other. We have tried to separate the effects in a statistical sense simply to show that children's comprehension of prose is dependent upon the operations applied to the material as well as the memory span for specific items. Also, this task assesses children's spontaneous comprehension processes and we do not wish to imply that young children cannot comprehend some of these linguistic inferences. They probably can when instructed to do so in simple tasks, but their normal comprehension strategies may not involve the implicit embellishment of information necessary for inferential comprehension and good memory.

We believe the results of studies like this one can be useful for those constructing language or reading comprehension instruments. Some structural specification of children's ability to construct inferential relationships may also provide insight into the mechanisms underlying these constructive comprehension strategies.

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Figure 1: Mean % Correct Responses on Verbatim and Inferential Questions by Grades

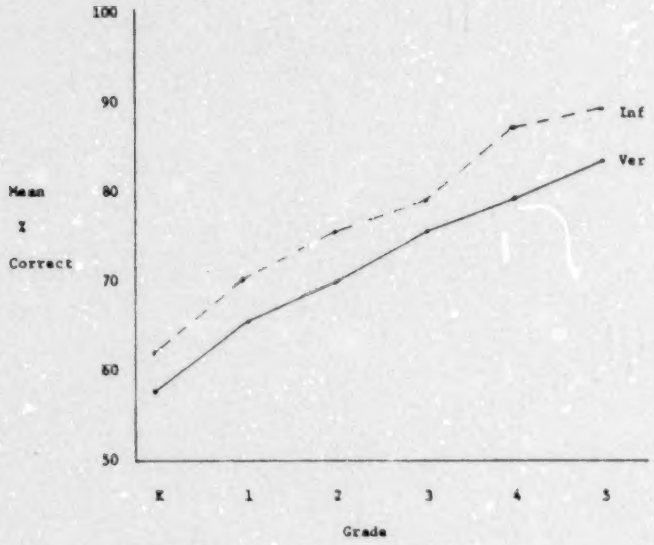

Figure 2: d's for Verbatim and Inferential Questions by Grades

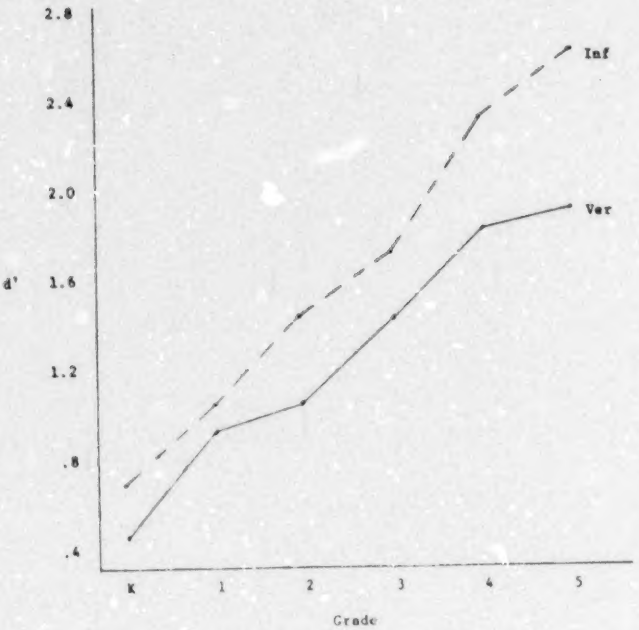

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Figure 3: Mean % Correct Responses for Question Categories by Grades

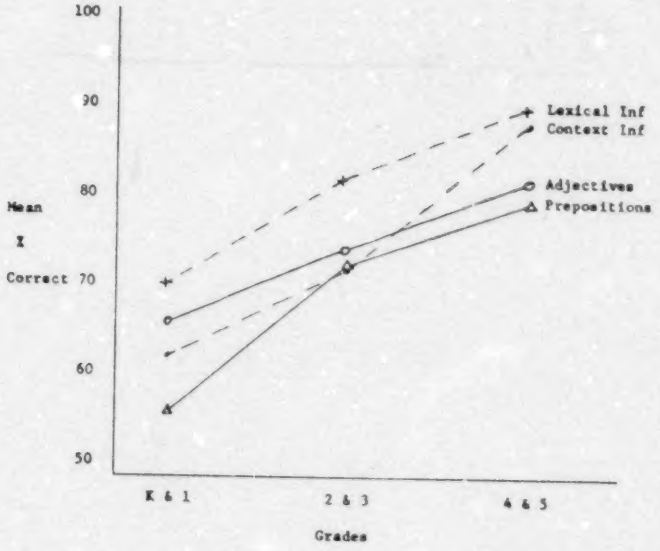

Figure 4: Mean % Correct for Adjectives and Consequences

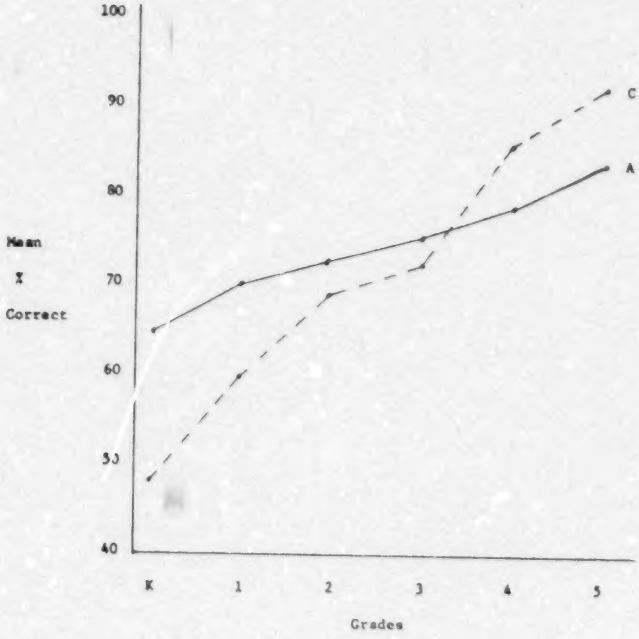

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Figure 5: Adjusted Mean % Correct Responses for Contextual and Lexical Inferences (Verbatim items were the covariate)

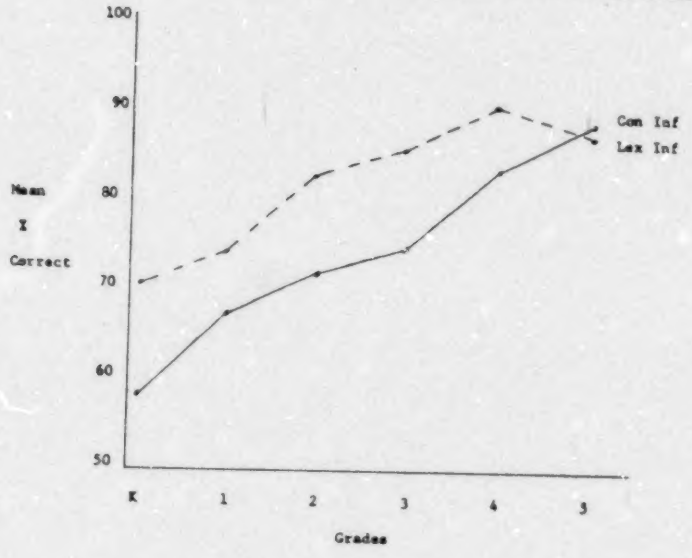

Figure 6: d's for Contextual Inferences and Adjectives by Grades.